



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ :		(11) International Publication Number:	WO 98/00207
A63F 1/00, 3/06, 9/24	A1	(43) International Publication Date:	8 January 1998 (08.01.98)

(21) International Application Number: PCT/US97/12765

(22) International Filing Date: 27 June 1997 (27.06.97)

(30) Priority Data:
 08/672,775 28 June 1996 (28.06.96) US
 08/692,454 5 August 1996 (05.08.96) US
 08/864,700 28 May 1997 (28.05.97) US

(71) Applicant: SILICON GAMING, INC. [US/US]; 2800 West Bayshore Highway, Palo Alto, CA 94303 (US).

(72) Inventors: ALCORN, Allan, E.; 660 Los Trancos Road, Portola Valley, CA 94028 (US). JENKINS, Harry, H.; 444 Kempton Road, Glendale, CA 91202 (US).

(74) Agents: HAMRICK, Claude, A., S. et al.; Oppenheimer Poms Smith, Suite 600, Ten Almaden Boulevard, San Jose, CA 95113 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

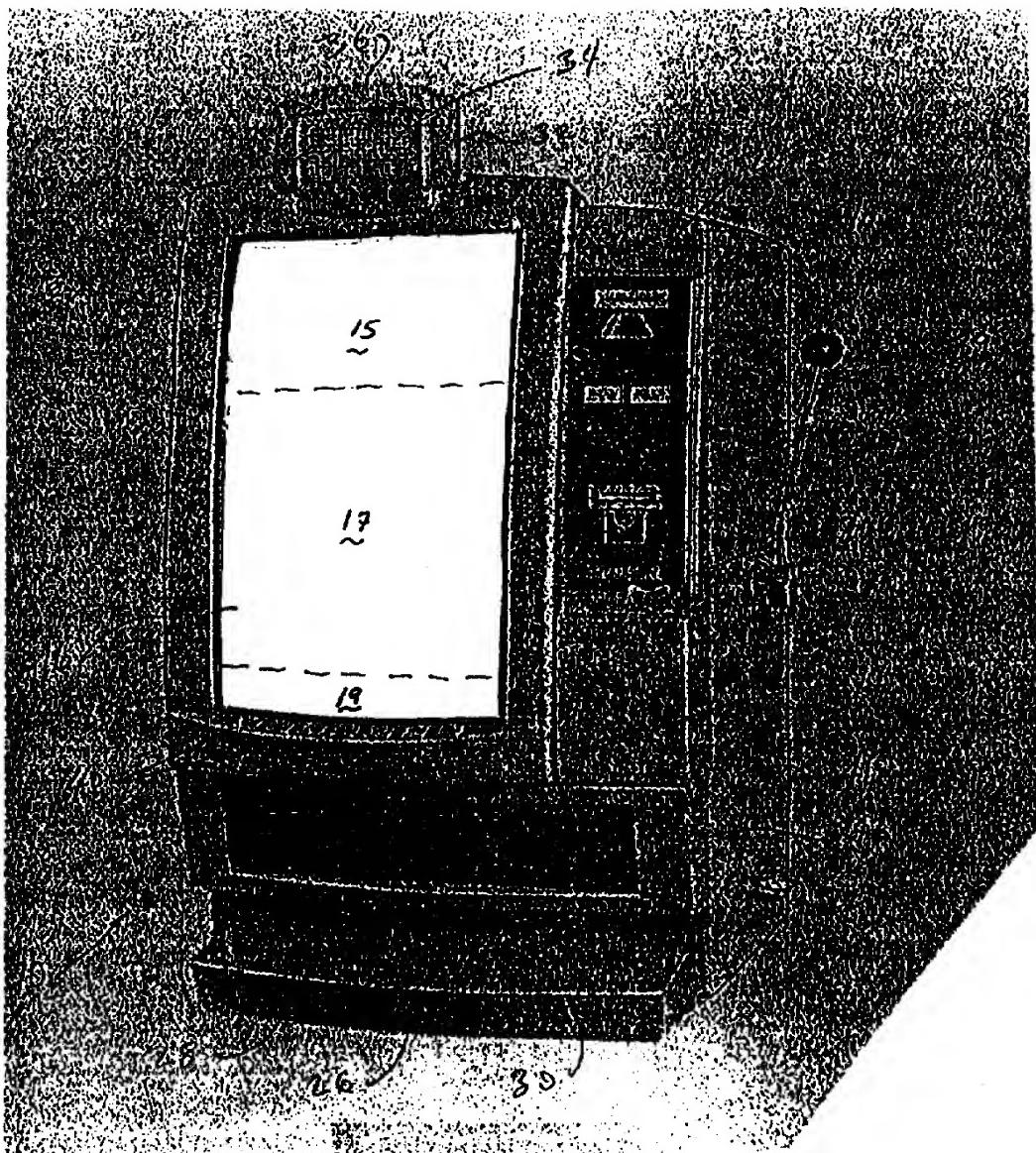
Published

*With international search report.**Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: IMPROVED ELECTRONIC GAMING APPARATUS

(57) Abstract

This invention is an electronic gaming apparatus (10), including a cabinet (12) for housing video and sound generating electronics (8, 30, 32, 34, 36), coin handling (20), payout (26) mechanism, and a video display screen (16). The preferred display screen (16) is substantially taller than it is wide and has a touch screen. Although the displayed video presentation may take any form, the preferred slot machine display embodiment includes graphics replicating the standard play board at top (15), game board in the middle (17), and principal user input interface below (19).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

Specification

5

IMPROVED ELECTRONIC GAMING APPARATUS**BACKGROUND OF THE INVENTION****Field of the Invention**

10 The present invention relates generally to electronic gaming apparatus, and more particularly to an improved gaming machine for improving the play and display of gaming graphics utilizing a vertically oriented video screen having touch screen input as a player interface to the device.

Relation to Other Applications

15 This application is a continuation-in-part of copending U.S. Application Serial No. 08/672,775 filed June 28, 1996, entitled "Dynamic Tournament Gaming Method and System," and is related to copending U.S. Application Serial No. 08/497,662 filed June 29, 1995, entitled "Electronic Casino Gaming System with Improved Play Capacity, Authentication and Security." Both applications are assigned to the Assignee of this present invention.

20

Brief Description of the Prior Art

25 Electronic gaming devices have long been provided for playing gambling games such as roulette, poker, bingo, keno, lotto and various other games, and have historically been constructed in a slot machine format typically including a pay board wherein the winning pay-out combinations are displayed; a play section in which electronic or mechanical reels, card-playing indicia or other gaming objects are displayed; and a third area in which a player interface is provided by means of an assortment of buttons, switches, etc. More modern gaming machines have included a video display screen (CRT tube) that is driven by an image generator coupled to a microprocessor that serves as the game controller. In such video implementations, standard television-style cathode ray tubes have normally been used, and electronically generated reels, cards and other objects have been depicted thereon for implementing play of the game. In some embodiments, the pay board is also included as part of the video display, but because this limits the active display area available for gaming presentation, a different screen or type of screen separate and apart from the video display is often utilized. Touch screen interfaces have also been used in gaming machines, but are often limited in their application because of the limited space available on the video screen. Another limitation of the prior art devices using video display screens is that the display has been quite sterile in its presentation, often comprising nothing more than an attempt to electronically present a two-dimensional image replicating the functional display elements of the prior art mechanical gaming apparatus.

30 There is thus a need for an improved gaming station or machine that uses modern video graphics and sound technology to provide a complete user interface that in at least one aspect conveniently integrates pay board, play screen, and player input interface in a single uniquely designed and oriented video screen format.

SUMMARY OF THE INVENTION

It is therefore a principal objective of the present invention to provide a gaming machine having an improved video display format and user interface which uses state-of-the-art video technology to provide animated 5 television-quality video and graphics displays.

Another objective of the present invention is to provide an electronic gaming machine having an electronic interface which is substantially larger than the standard television-type video screen typically used in present casino-type games.

Still another objective of the present invention is to provide an improved user interface for slot machine-10 type games that readily accommodates in well-known three-part format, but on a single screen, the pay board, play screen, and user interface commonly used in gaming stations.

Yet another objective of the present invention is to provide an enlarged video display screen which provides a complete display of all gaming essentials, yet generally conforms to the familiar and more or less standard "slot machine" footprint and height-to-width ratio common in casinos throughout the world.

15 A further objective of the present invention is to provide a gaming machine having both lifelike graphics and realistic high-quality sound generators.

Briefly, a presently preferred embodiment of the present invention includes a cabinet for housing video and sound generating electronics, coin-handling and pay-out mechanisms, and a video display screen. The display screen is substantially taller than it is wide and preferably has a touch screen associated therewith. Although the 20 displayed video presentation may take any form, the preferred slot machine display embodiment includes graphics replicating the standard play board at top, game board in middle, and principal user input interface below.

An important advantage of the present invention is that since it uses a video screen that is substantially taller than it is wide, all familiar aspects of a standard slot machine can be dynamically and graphically presented on the video screen in their usual positional format.

25 Another advantage of the present invention is that a multitude of different types of games can be selectively displayed on a single gaming station.

Still another advantage of the present invention is that unusual attract modes can be selectively displayed on the video screen to attract the attention of potential players.

30 A still further advantage of the present invention is that unusual video displays can be presented to communicate and perhaps hold the attention of players as well as observers.

35 Yet another advantage of the present invention is that since a large part of the frontal surface area is occupied by the display screen, a plurality of adjacent machines can be electronically linked together and driven in concert with complementary video to create a segmented "picture wall" effect when not in use by players. And even when in use, an integrated background display can be used to change environmental "mood" or "setting" of the game room.

These and other objects and advantages of the present invention will no doubt become apparent to those skilled in the art after having read the following detailed description of the preferred embodiments which are illustrated in the several figures of the drawing.

IN THE DRAWING

Fig. 1 is a perspective view illustrating a gaming machine in accordance with the present invention;

Fig. 2 depicts a typical screen display in accordance with the present invention;

Fig. 3 is a functional block diagram illustrating the principal functional components used in the gaming

5 machine of the present invention.; and

Figs. 4, 5 and 6 are diagrams generally illustrating software architecture and features of the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the present invention is depicted at 10 in Fig. 1 and includes a more or less 10 rectangularly configured cabinet 12 forming an enclosure for the various functional mechanical, electrical and electronic components. The front face 14 of cabinet 12 is uniquely configured to include as the principal component thereof a video display screen 16 disposed in portrait format with its vertical dimension being substantially larger than its horizontal dimension. As is apparent from the illustration, the screen 16 occupies a substantial part of the front face of the device 10. Positioned to the right of screen 16 is a currency input section 18 including a coin-receiving slot 20, a paper money-receiving slot 22, and a credit/debit card slot 24. A pair of buttons 23 and 25 may be provided for allowing the player to select a "cash" or "credit" mode for payout of 15 winnings.

Disposed beneath screen 16 and at the bottom of the front face is a coin drop receptacle 26. Immediately 20 above the coin drop receptacle are a pair of high-quality audio speakers 28 and 30. Above screen 16 is an annunciator 32 including a third high-quality audio speaker or signal generator 34 and a multi-colored, multi-light 25 display apparatus 36. Disposed immediately beneath screen 16 on a slightly protruding shelf 38 are a plurality of user interface buttons 40 that are of conventional configuration. Formed integral with the front face of display screen 16 is a transparent touch screen that is dynamically configurable to allow manual user inputs at screen positions determined by the software associated with the particular game or attract mode being presented.

On the right side of cabinet 12 is a conventional pull handle 39 that may be optionally used as a part of the 25 user interface to the gaming apparatus.

The cabinet 12 was designed to coincide with the overall dimensions of traditional slot machines so that the device can be placed in existing casino carousels without requiring reconfiguration of the stands or machine 30 layouts. The right side of the cabinet forms a compartment for containing currency input devices such as coin and bill acceptors, a card reader, keypad, and perhaps a display for a player tracking network interface. A locked service door 41 forms the right side wall of the cabinet and allows access to the currency components in this section. The front 43 of the lower section of the enclosure contains a coin hopper (a cache of coins that is used to pay out the player's winnings when playing in cash mode). The back of the lower section of the cabinet (behind the hopper) contains a CPU box with all of the associated electronics and power supplies. A locked service door 35 allows access to the hopper in this section.

Player tracking network electronics are located in the top of the system and are accessed by removing a top cover (not shown).

The cabinet layout, which is more or less traditional for video-type slot machines, leaves a tall and narrow section at the upper left for the CRT that forms the display screen 16. To maximize the screen area in the available

space, a 26", wide screen CRT display device rotated 90° into a "portrait mode" is used with the screen origin at the bottom left corner, and the image scanned from left to right. For purposes of this disclosure "portrait mode" is defined as a display configuration in which a display screen has a height dimension that is substantially larger than its width dimension. The wide screen CRT has a 16x9 (height to width) aspect ratio and a 0.69mm dot pitch allowing for an 856x480 visible display area. Portrait mode configured display screens or CRT's having other aspect ratios may also be used. For example, although less desirable, a standard 4x3 CRT monitor rotated into a portrait mode could be used.

In accordance with one aspect of the present invention, when operating in a game play mode, the display screen may be electronically subdivided into three arbitrarily sized regions: an upper region 15 in which a pay board will be displayed, setting forth the jackpot payouts as a function of the coins input; a mid region 17 in which a game board, play reels, card hands, or other game play indicia is displayed; and a lower region 19 in which touch screen "buttons" are displayed for facilitating player selection of various input functions such as "hold", "bet 1", "draw", etc. One example of a "3-way" screen configuration is illustrated in Fig. 2. Depending on the particular game being played, the dimensions of these regions may change. Furthermore, the configuration of the touch screen responsive areas within each region may likewise change to correspond to associated graphics displayed in one or more of the regions. Moreover, in "attract mode" the screen may be subdivided into a geometrical grid of regions, e.g., a 2x4 or 2x6 (etc.) grid in which passive or active game logos may be simultaneously displayed for selection by a player. In such mode the touch screen would typically be configured to call up the game corresponding to the logo touched by the player.

An integrated touch screen overlaying the display screen, along with the series of "hard" buttons 40 arrayed along the bottom edge of the display, provide the main player interface to the system.

In Fig. 3 of the drawing, a generalized block diagram depicts the principal functional components of the system and includes a central processing unit (CPU) 45, the CRT 16, a user interface 42 that includes the touch screen buttons 40 and pull handle 39, a video storage subsystem 44, an audio storage subsystem 46, a disk storage subsystem 48, a peripheral memory subsystem 50, an annunciator and sound system 52, a network I/O 54, a card reader 56, a coin handler 58, and a bill reader 60. In the preferred embodiment, CPU 45 is a 133MHz Pentium processor using a combination of the DUCK Video Codec for motion video, A-RL (Alpha Run-Length) decoding of static graphics, and software compositing for the individual elements.

Although not shown in detail herein, the CPU 45 includes a motherboard, a PCI-based video board and SCSI controller, a peripheral memory board, a GPIO board, a power transformer, a disk drive, and a CPU power supply. The peripheral memory board is installed on the mother board PCI bus and is used to replace the BIOS ROMs of the standard PC architecture. Whereas on standard mother boards the PCI-to-ISA bridge (PIB) chip provides the interface to the system BIOS ROMs by subtractive decoding of PCI accesses in the normal PCI BIOS range and its high-memory aliases, the peripheral memory board in the preferred embodiment responds to accesses to the BIOS address range using positive decoding, responding to the requested cycles before the PIB chip responds. This allows the ROM-based BIOS and OS to reside at these locations without modifying the mother board.

In addition, the peripheral memory board provides a removable subsystem containing all of the machine states, thereby allowing secure system auditing. The peripheral memory board contains 1MB of EPROM to hold

the BIOS and OS (including the secure loader described below), 64KB of nonvolatile RAM to implement a SafeStore system, and 128KB of electrically erasable PROM (EEPROM) to store the system configuration.

A peripheral memory controller performs byte-assembly and disassembly on memory reads/writes and parity generation on the PCI reads.

5 The preferred embodiment exhibits total immunity to Electric-Static Discharge (ESD) to a level of 27KV. The requirement for this level of ESD immunity is an artifact of low humidity and prevalence of synthetic materials (carpeting, etc.) in Nevada casinos. All standard mother boards support an IEEE 1284 compatible parallel port, and such port provides the interface to the general purpose input/output (GPIO) board. The GPIO board provides an electrically isolated interface to the external device ports and maps them to registers accessible through the mother 10 board parallel port.

The system software is designed to address the unique requirements of casino gaming machines, including high reliability and security, fault detection and recovery, and responsive performance. The system software architecture is illustrated in Fig. 4.

15 A pSOS real-time operating system serves as the basis for the software platform of the preferred embodiment. This pSOS system consists of a multi-tasking kernel, the pREPC, ANSI-C, run-time library functions, and a driver support library to access physical devices through a set of device drivers. The run-time Application Programmers Interface (API) is a layer of system software providing a set of standard functions that application programmers develop to. Because the API provides a layer of abstraction between the applications and the hardware, the applications are not affected if the hardware or lower level system software are modified. The 20 API is divided into a series of managers, each of which provides either access to some physical device or provides some set of services for the programmer. Examples of these managers are shown in the table illustrated in Fig. 5.

25 The system applications include a Navigator, Play Stoppage, a suite of games, and the Machine Management System. The Navigator presents the player with an animated icon of each game. The animation describes the key features of the game; users enter a game by touching its icon. Each game is a custom application offering a specific set of propositions to the player. Each game is accompanied by on-line help that describes the rules of play, general disclaimers for the game, and so on. Play Stoppage is an application that runs short animations or video segments that entertain the player if a system fault occurs, while communicating information about why a game was interrupted and when it will be returned to play. The Machine Management System (MMS) provides a graphical interface to all technical support functions of the slot machine. This includes player conflict 30 resolution, accounting, product configuration, and machine diagnostics.

35 As described in detail in the above-referenced U.S. Patent Application Serial No. 08/672,775, before software can be loaded from the hard disk, it must be verified as being an authentic proprietary product. A secure loader is the system software component that loads executable files from the disk subsystem into RAM, verifies that the contents are correct, and then executes the image. The secure loader is based on the use of two-key cryptographic authentication from RSA Data Security, Inc. of Redwood City, California.

When a software release is ready for shipment, a HASH function designed for cryptographic use generates a unique fixed-length string of 128 bits for the loadable code image. This string, called a message digest, is then encrypted using RSA software and the proprietor's private key to produce a digital signature for the image. The signature is then written to disk with the loadable code image. When the code image is loaded from the disk and is

ready to be executed during the system boot sequence, the secure loader decrypts the digital signature using the -
public key stored in ROM. The secure loader verifies that the image is authentic by comparing the message digest
computed for the loadable code image with the message digest decrypted from disk. The software can be
authenticated at any time since the console diagnostics include tools that allow the operator to query all loadable
5 applications and run the RSA verification algorithm on them on demand. The authentication process is not limited
to just software images. Graphics files or any binary data set can be authenticated. Because the graphics images
are so large, they are not verified every time a game is loaded. If needed, critical graphic images such as the faces
of cards can be verified before initial use in a game.

A SafeStore application provides fault-tolerant storage for critical system data called safe objects stored in
10 system nonvolatile SRAM. To facilitate recovery of information after a crash or system failure, state information
about each safe object along with the object data is saved in an internal format known as a binary large object
(BLOB). To protect against hardware or software faults corrupting SafeStore, all safe objects are mirrored across
two independent nonvolatile SRAMs. If corruption occurs by hard or soft failures to indicate locations in SRAM,
or if complete SRAM failures occur, SafeStore will detect this corruption and recover the data.

15 Fig. 6 depicts a BLOB in SafeStore with all of the important BLOB header fields. The data check sum
fields 0 and 1 contain the check sums of the data in data areas 0 and 1, respectively. The active data area pointer
field indicates that data area 0 contains the latest data written to SafeStore. The BLOB header check sum field
contains a check sum of the BLOB header, including the data area check sums and the data area pointer. During a
SafeStore update, the BLOB header is read into main memory where the header check sum is computed and
20 checked against the value of the header check sum field. If the check sum does not match, the system will tilt.
Assuming it matches, the new data is copied into the inactive data area. The copy of the BLOB header in main
memory is updated with the check sum of the new data; the active data area pointer is updated to point to the data
area 1; and the new header check sum is computed and written to SafeStore.

25 Although the present invention has been described above in terms of specific embodiments, it is
anticipated that alterations and modifications thereof will no doubt become apparent to those skilled in the art. For
example, it is contemplated that video screens formed by other apparatus such as liquid crystal displays, field
emission displays, interference element displays, projection TV, and perhaps holographic and other display
technology may be used in place of the CRT device presently used in the preferred embodiment. Furthermore,
other cabinet configurations and designs may be used to support a large portrait-mode display screen, and whereas
30 the preferred embodiment utilizes a single means to form the display screen, it is contemplated that a similar result
may be achieved by using a plurality of contiguous display devices synchronously driven to display different
portions of a common image. It is therefore intended that the following claims be interpreted as covering all such
alterations and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

CLAIMS

1. A gaming machine comprising:
a cabinet having a front face to be addressed by a game player;
video display means including a player viewing screen occupying a first portion of said front face, said screen having a vertical dimension substantially larger than its horizontal dimension;
player interface means associated with said front face; and
electronic means disposed within said cabinet and including programmable means responsive to player input via said player interface means and operative to generate video signals for causing said video display means to display video game graphics on said display screen.
2. A gaming machine as recited in claim 1 wherein said video display screen has a 16x9 aspect ratio.
3. A gaming machine as recited in claim 1 wherein said video display means includes a cathode ray tube having a display screen with a 16x9 aspect ratio.
4. A gaming machine as recited in claim 1 wherein said video display means has an associated touch screen forming at least a part of said player interface means.
5. A gaming machine as recited in claim 3 wherein the line traces of said cathode ray tube are orthogonal relative to displayed image horizontal directions.
6. A gaming machine as recited in claim 1 wherein said display screen is electronically divided into three vertically stacked regions, the lower region forming a user interface region, the middle region forming a gaming display region, and the upper region forming a pay-out chart region.
7. A gaming machine as recited in claim 1 wherein said cabinet includes an annunciator means disposed above said display screen.
8. A gaming machine as recited in claim 1 wherein said electronic means includes a stereo sound generating means.
9. A gaming machine as recited in claim 1 wherein said player interface means includes a plurality of buttons for allowing a player to assert gaming input selection.
10. A gaming machine as recited in claim 1 having currency input means occupying a second portion of said front face.

11. A gaming machine as recited in claim 1 and further comprising currency pay-out means associated with a third area of said front face.

12. A gaming machine as recited in claim 1 wherein said programmable means includes a central processing unit, a video data storage means, an audio data storage means, and a disk storage means.

13. In a gaming machine including a display means, electronic means for driving the display means to produce gaming images thereon, and player interface means, an improved display means comprising:
means forming a display screen having a vertical dimension that is substantially larger than its horizontal dimension.

14. In a gaming machine as recited in claim 13 wherein said display screen is formed by the image producing surface of a cathode ray tube.

15. In a gaming machine as recited in claim 14 wherein the line traces of said cathode ray tube are orthogonal relative to displayed image horizontal directions.

16. In a gaming machine as recited in claim 13 wherein said display means is a video display device having an aspect ratio of 16x9.

17. In a gaming machine as recited in claim 16 wherein said video display means has an associated touch screen forming at least a part of said player interface means.

18. In a gaming machine as recited in claim 16 wherein the line traces of said cathode ray tube are orthogonal relative to displayed image horizontal directions.

19. In a gaming machine as recited in claim 13 wherein said programmable means includes a central processing unit, a video data storage means, an audio data storage means, and a disk storage means.

20. In a gaming machine as recited in claim 19 wherein said interface means includes at least one of the following: a touch screen; a plurality of manual input buttons; an actuating handle; a card reader; a coin handler; a bill reader.

21. A gaming machine as recited in claim 1 wherein said video display means includes a cathode ray tube having a display screen with a 4x3 aspect ratio.

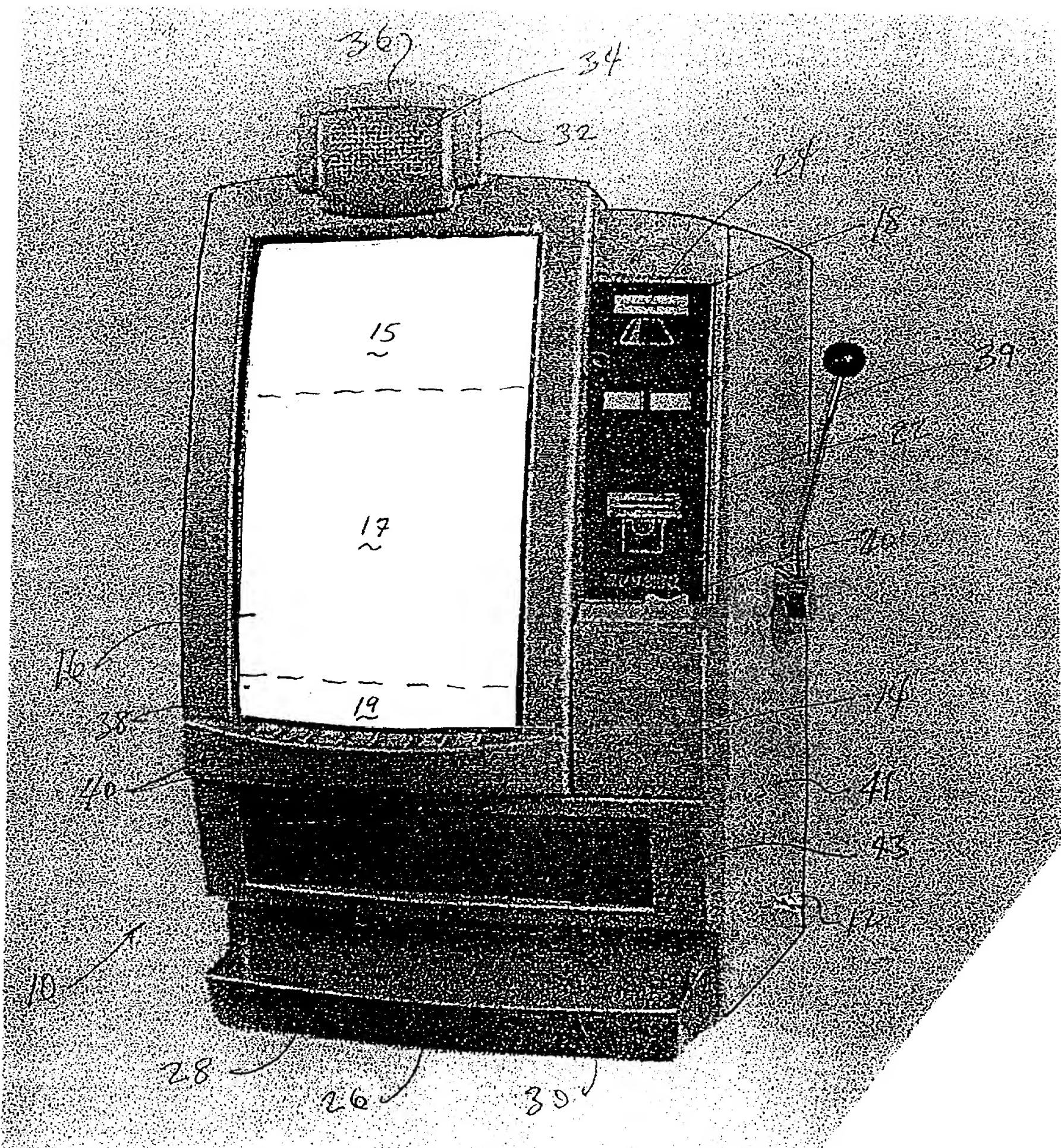


Fig. 1

2/4

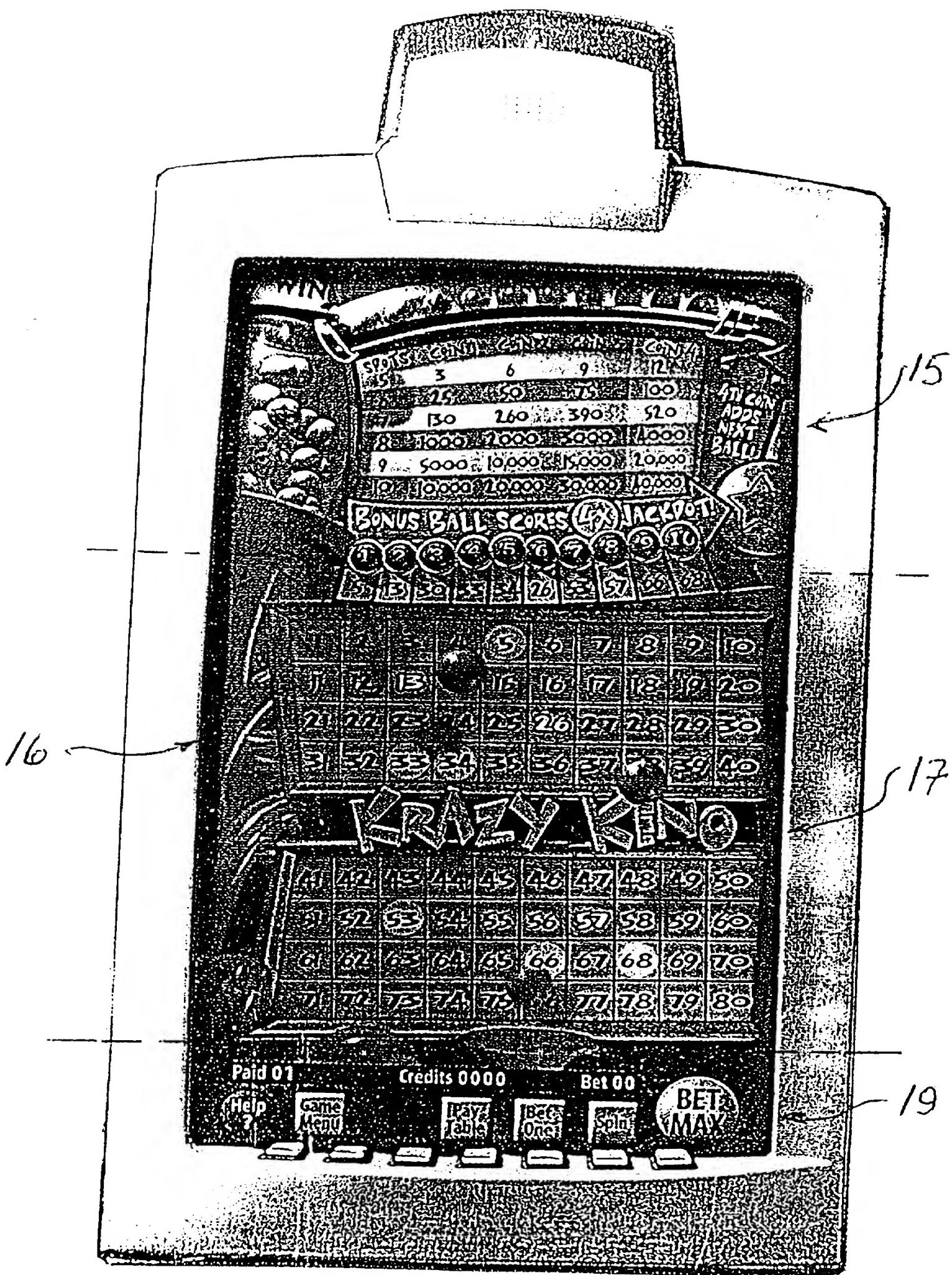


Fig. 2

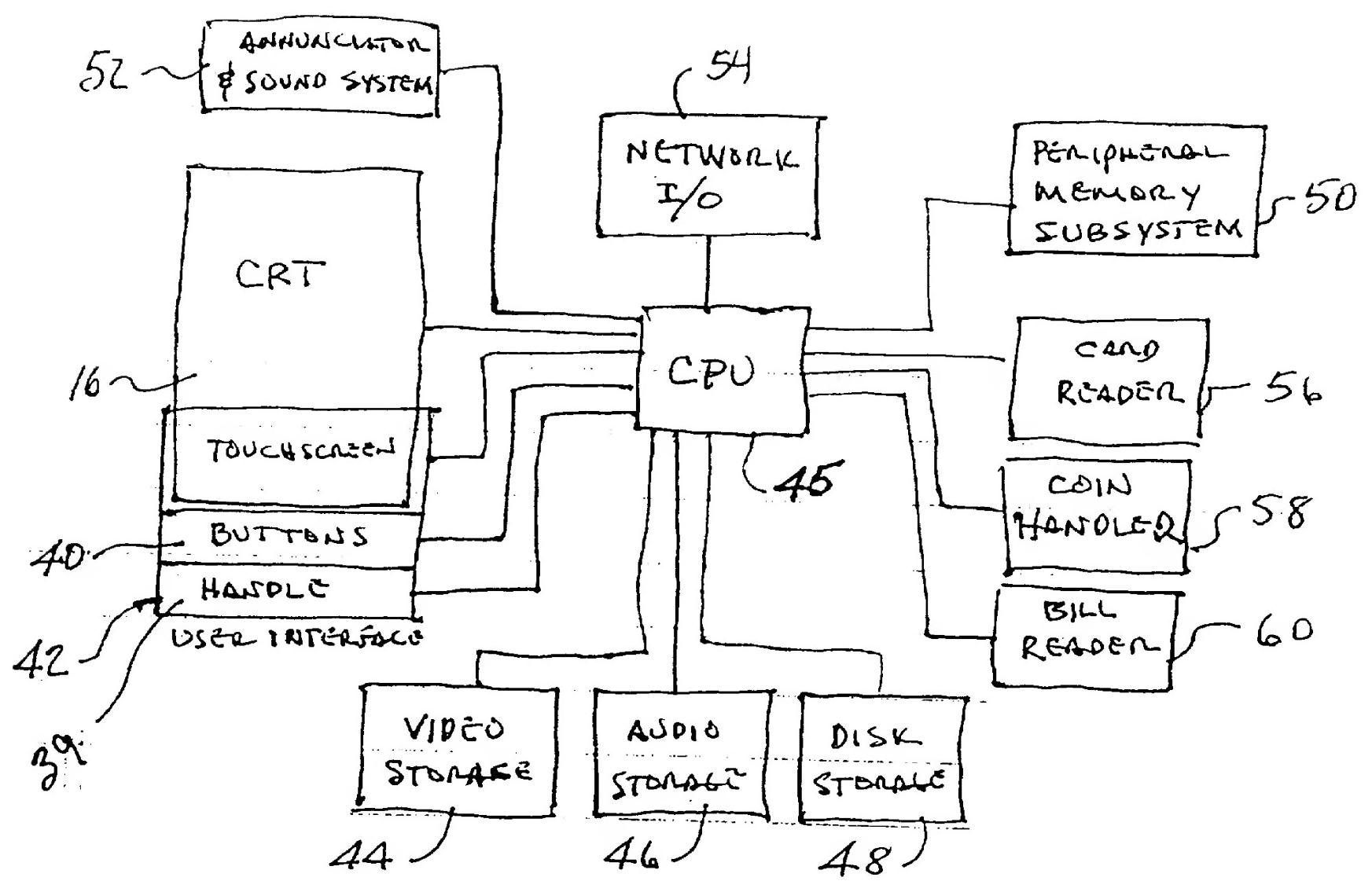
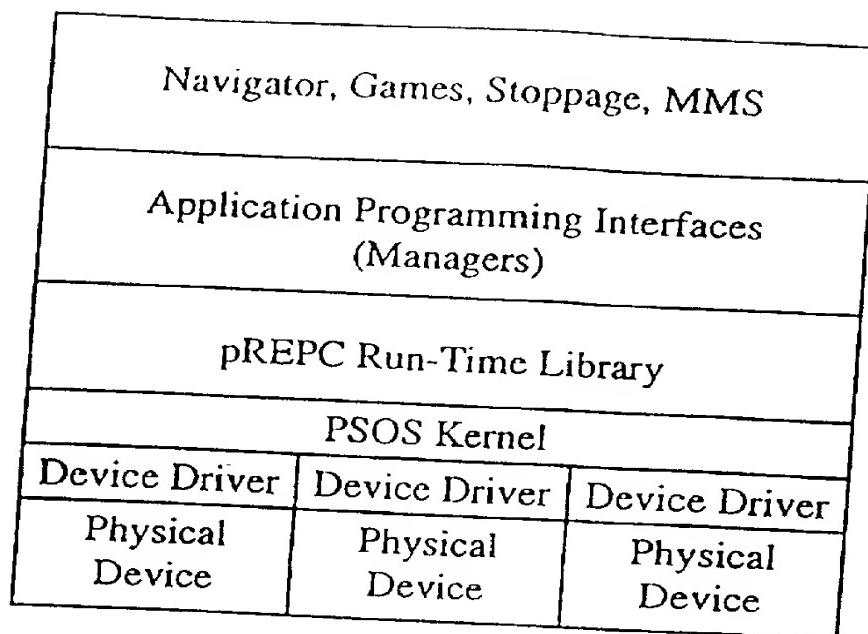
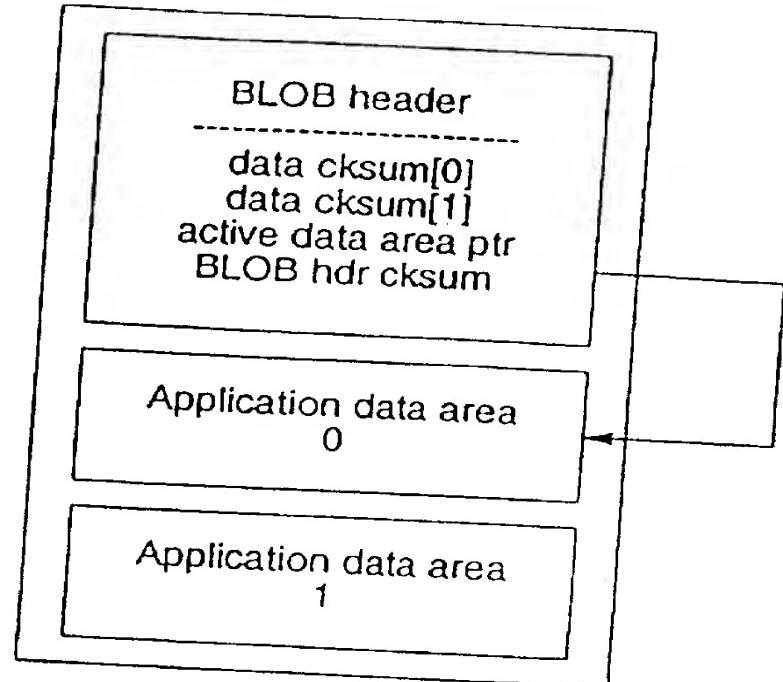


Fig. 3

*Fig 4**Fig 6*

Manager	Description
Data Streamer	Enables an application to use data within a large file without loading the entire file's contents into memory.
Display Manager	Enables an application to control screen drawing to the video display.
Cash Manager	Provides the application with a secure interface for monetary transactions .
Hotspot Manager	Provides the application interface to the touchscreen.
Button Manager	Provides the application interface to the hard buttons on the slot machine bezel.

Table

Fig 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/12765

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A63F 1/00, 3/06, 9/24

US CL : 463/13, 14, 16, 20, 25, 46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/173; 348/426; 463/1, 13, 14, 16-20, 25, 30, 31, 35-37, 40, 42, 46

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,429,361 A (RAVEN et al) 04 July 1995, Figs. 1-3.	7, 12, 19
Y	US 5,356,140 A (DABROWSKI et al) 18 October 1994, Figs. 1-8.	6
Y	US 4,951,149 A (FAROUDJA) 21 August 1990, col. 1, lines 12-28, and col. 4 lines 15-57.	1-21
Y	US 4,856,787 A (ITKIS) 15 August 1989, col. 2 lines 6-48, and Figs. 1-7.	1-21
Y	US 4,614,342 A (TAKASHIMA) 30 September 1986, col. 2 lines 9-31, and Fig. 3 (20).	1-21

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

18 SEPTEMBER 1997

Date of mailing of the international search report

29 OCT. 1997

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

MARK A. SAGER

Telephone No. (703) 308-0785